Targeted Temperature Management

- Targeted Temperature Management (formerly Therapeutic Hypothermia) is the intentional cooling of a patient to 33-36°C for 18-24 hours post-cardiac arrest.
- Multiple studies have shown induced therapeutic hypothermia improves neurologic function in post-cardiac arrest patients when initiated within six hours of the arrest, starting with two landmark studies in 2002.
- The American Heart Association in 2005 listed induced hypothermia as one of the guidelines for post-cardiac arrest care.

How Does It Work?

- Initial neurologic injury occurs when circulatory collapse impairs oxygen flow to the brain. Without oxygen, the brain switches to anaerobic metabolism, resulting in excessive calcium and glutamate release and neuroexcitation, leading to further hypoxemia, which disrupts the blood-brain barrier and worsens cerebral edema.
- Hypothermia counteracts neuroexcitation in brain cells by stabilizing calcium and glutamate release, reducing the degree of cell death. It also stabilizes the blood-brain barrier, reducing cerebral edema. Cerebral metabolism decreases 6% to 10% for every degree Celsius that body temperature drops. As cerebral metabolism declines, the brain needs less oxygen.
- Hypothermia counteracts many of the destructive mechanisms of cardiac arrest. Similarly, hypothermia halts destructive brain mechanisms and lets the brain reset itself to normal functioning.
- Decard & Ebright (2011).
When someone asks how slow to push drugs during a code

Well, he ain't getting any deader!

Targeted Temperature Management Review

- **Two Landmark Studies**
  - Holzer (2002) concluded therapeutic hypothermia results in a significant increase in the rate of a favorable neurologic outcome and reduced mortality in those who were successfully resuscitated after cardiac arrest due to ventricular fibrillation.

- Lundby (2012) conducted a study suggesting therapeutic hypothermia is associated with favorable neurologic outcome and survival in patients resuscitated after cardiac arrest due to non-shockable rhythms including asystole and pulseless-electric activity.

- Dumas et al. (2011) performed a study that concluded hypothermia was independently associated with an improved outcome at hospital discharge in patients presenting with a shockable rhythm, but was not associated with good outcome in non-shockable patients.

- 2015 guidelines of post-cardiac arrest care by the American Heart Association amended its recommendations, adding all comatose patients with return of spontaneous circulation (ROSC) receive therapeutic hypothermia regardless of initial rhythm (Callaway et al., 2015).
Targeted Temperature Management Review

- After cardiac arrest and successful resuscitation, patient can be determined if he/she is a candidate for TTM.
- Several Inclusion & Exclusion Criteria.
- Multiple Cooling Methods:
  - Ice Pack
  - Cooled Saline
  - Gaymar Unit
  - Zoll Catheter
- Cooled for 24 hours
- Slowly rewarmed
- Neurological Function assessed

Targeted Temperature Management Review

- Multiple studies have been published suggesting early initiation and fast achievement of therapeutic hypothermia is associated with better neurologic outcomes (Testori et al., 2014; Wolff et al. 2009).
- Targeted Temperature Management has no effect on cardiac function, only neurologic.
- Studies suggest that initiation in the emergency department gives patients a possible advantage for better recovery (Castelblanco, 2011).
- Bigham, Dainty, Scales, & Brooks (2009) published a study showing hypothermia has been shown to improve neurologic outcomes, but application rates are less than 30%.
- Critical Care Medicine journal published a study on perceived barriers in therapeutic hypothermia care. Lack of education and awareness were listed as barriers (Toma et al., 2009).

Bottom Line
**Cardiac Arrest**

- **Targeted Temperature Management**
  - ACLS
  - Hemodynamics
  - Full Support
  - ROSC
  - Ventilation
  - Arterial Blood Oxygenation
  - Full Assessment
  - Interventions
  - Therapy for TTM

**How It Works…**

**Therapeutic Hypothermia Lowered Brain Damage Following Cardiac Arrest!**

- Cardiac Arrest
- Hypothermia
- Cardiac Support
- Therapeutic Hypothermia
- Core Cooling
- Cool Canister
- Core Temperature
- Brain Temperature
- Core Temperature Monitoring

**Cardiac Arrest**

- Full Advanced Cardiac Life Support Measures
  - Intubation
  - CPR
  - Defibrillation
  - Medications
    - Epinephrine
    - Isoproterenol
    - Amiodarone

- Correct Abnormalities
  - ABG, pH
  - Acidosis
  - Electrolytes

- Hemodynamic Support
  - Pressures, inotropes, etc.

**ACLS**
Return of Spontaneous Circulation

- Maximize Hemodynamic & Respiratory Support
  - Vasopressors Support
  - Hyperventilation
- Baseline Assessment
  - Neuro Assessment
  - Pupillary Reaction
  - Vital:
  - Respiratory Effort
  - Blood
- Initial Rhythms
  - V/F/T: Immediate Cardiac Consultation
- Further/Immediate Intervention?
  - Cardiac Cath?
  - Abnormality/Infection?
  - Par-Scan

Targeted Temperature Management

Inclusion Criteria:
- Cardiac Arrest/ROSC within 6 Hours
- GCS 8
- SBP >90
- Mechanical Ventilation
- >16 Year Old Patient

Exclusion Criteria:
- ROSC >6hrs Prior
- GCS >8; Purposeful Movements
- Initial Temp <30
- MAP <60 with Interventions
- Terminal Illness
- DNR Standing
- Coagulopathy/Active Bleeding
- Primary Intracranial Event
- Arrest Secondary to Severe Sepsis
- Major Surgery in Last 72 Hours
- Trauma Patient at Risk for Bleeding

Alternative Targeted Temperature Management: 36 Degrees

- Mild Hypothermia/Normothermia for Excluded Patients

Inclusion:
- Mild Coagulopathy: Platelets <100,000 or 30,000-50,000
- Pregnant with OB Consult
- Complications (Hypotension, Arrhythmia
- Sepsis/Severe Sepsis
Start The Cooling!

- Once patient has been determined eligible for TTM:
  - Immediately place ice packs to axilla, neck, and groin region
  - 2L Cooled Saline Infusion
  - Post-Arrest Labs
    - ABG
    - CBC, Chemistry + Mag + Phos
    - Cardiac Enzymes
    - Lactate
    - Blood Calcium x 2
  - Arterial Line Placement
  - Central Line or Invasive Cooling Line
  - Internal Temperature Probe
  - Esophageal Temperature Probe
  - Foley Probe unless urine output <60 ml/hr
  - Rectal Probe

Don’t Wait!!!

A large study by Sendelbach et al. (2012) concluded the odds of poor neurological outcome increased with each 5-minute delay in initiating therapeutic hypothermia treatment, and the delay in induction of cooling measures led to a delay in time to target temperature, of which the study states increases chances of poor neurological outcome for every 30-minute delay in time to target temperature. Yochum & Utley (2016) found creation of an Emergency Department TTM protocol decreased time of induction from 127.8 minutes to 15.73 minutes.

Invasive Cooling Methods

- Gaymar Surface Cooling
- ZOLL Cooling Catheter
- IV Fluids
- Blanketroll II
No definitive targeted temperature.

Research cases range from 33-36 degrees Celsius.

Nielsen et al. (2013) conducted a study evaluating targeted temperature management at 33 degrees versus 36 degrees, and found no significant difference in outcomes or benefits.

The American Heart Association in its 2015 Advanced Cardiac Life Support guidelines modified its therapeutic hypothermia guidelines, stating “we recommend selecting and maintaining a constant temperature between 32°C and 36°C during targeted temperature management” (Callaway et al., 2015).

Best if obtain goal temperature in <4 hours from ROSC.

Temperature: 34-36 Degrees

Assess for Shivering Every Hour

Acetaminophen, Buspirone, Fentanyl, Meperidine, Propofol, Cisatracurium.

Supportive Therapy

Maintenance of BP & CVP ≥ 9-12

Strict intake/output.

Frequent labs: WBC, Platelets.

Medications & Electrolytes

Propofol, Sevoflurane, Succinylcholine.

Gastronomy, Intravenous, Hyperalimentation, Glucose 120.

Magnesium 120.

Labs: Chemistry, ABG, Magnesium, and PT/PTT/WBC every 6 hours.

### Adverse Effects

- Unable to reach target temp within 4 hours.
- Urine Output <0.5 mL/kg.
- Resistant Shivering.
- MAP < 80 and/or CVP < 8.
- Serum K+ > 5.0.
- Arrhythmias.
- Seizure/Posturing.
- Worsening Coagulopathy.
Neurologic Prognosis

- Cannot be determined until:
  - Patient Completely Rewarmed
  - Paralytics Have Metabolized based on Train of Four
  - Sedation Weaning/Metabolization
  - EEG
  - Continuous versus Regular
  - Diagnostic Imaging
    - MRI
    - CT Head

Rewarming

- Begins 24 hours after achieving goal temperature
- Re-warm at rate of 0.25 degrees until reaches 36 degrees
- Turn off Paralytics
- Begin Weaning Sedation/Analgesia
- Monitor for hypotension and hyperkalemia
- Warming may take up to 12 hours
- Leave Temperature Control device in place to prevent rebound hyperthermia

Statistics

- According to AHA 2015 Heart & Stroke Statistics (Mozaffarian et al. 2015):
  - Incidence of out-of-hospital cardiac arrest is 326,200.
  - Average survival rate is 10.6%.
  - Survival with good neurologic function is 8.3%.

- In 2009, a review and compilation of recent experiences of therapeutic hypothermia after cardiac arrest was performed and published in Critical Care Medicine. The authors compiled protocol methodology from multiple hospitals and looked at survival to hospital discharge and neurological outcomes. The results confirmed hypothermia did maximize chances of a meaningful recovery. The findings showed the use of therapeutic hypothermia increased survival with an odds ratio of 2.3, and favorable outcome with an odds ratio of 2.5 (Sagalyn, Band, Gaiesky, & Abella, 2009).
Conclusion

TIME IS BRAIN!

References

References Continued


